

# THE HIERARCHICAL STRUCTURE OF THE PHYSICAL SELF: AN IDIOGRAPHIC AND CROSS-CORRELATIONAL ANALYSIS

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## ABSTRACT

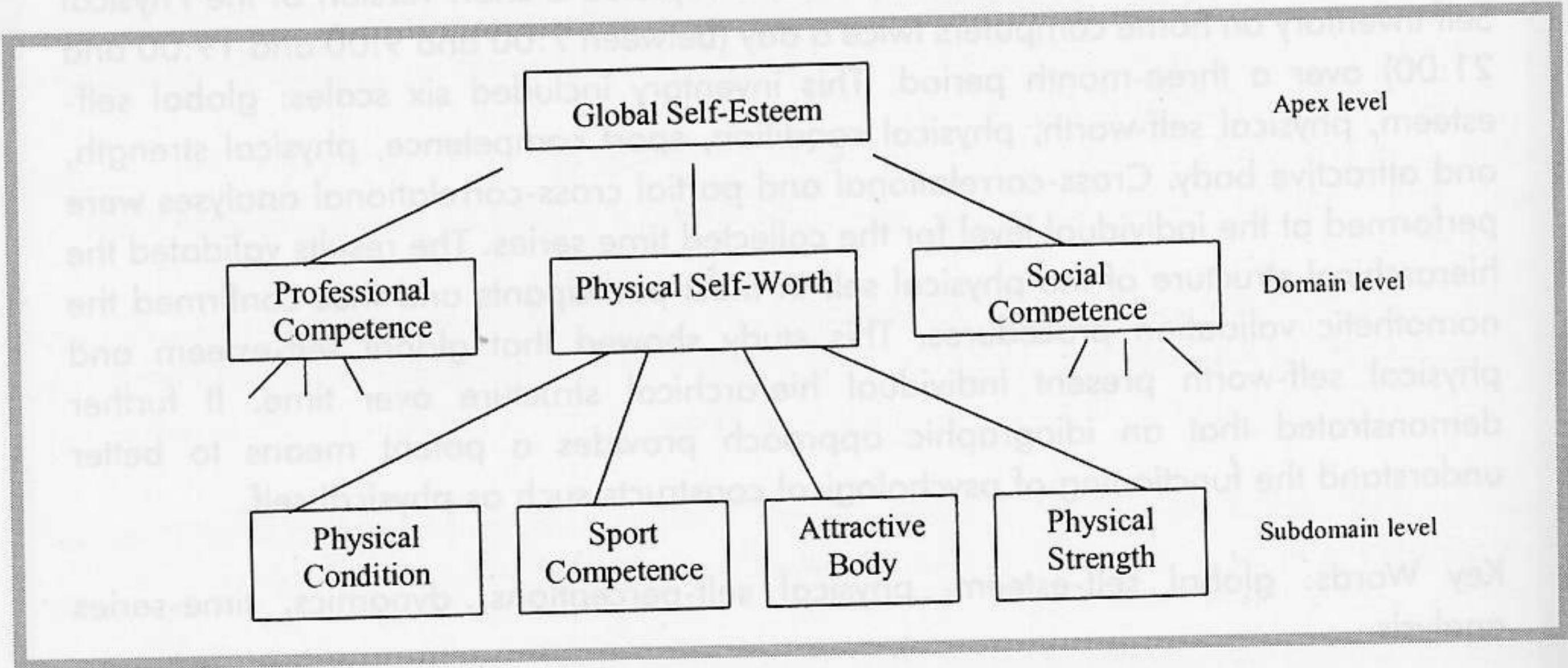
This study investigated the hierarchical structure of global self-esteem and physical self over time by focusing on intra-individual dynamics. Although the hierarchical model has been studied and validated from a nomothetic point of view, validation from an idiographic approach is important as well to demonstrate its maintenance within individuals, since its functioning depends on individual and dynamic processes. Eleven participants (mean age: 33.9 years ( 15.0) completed a short version of the Physical Self Inventory on home computers twice a day (between 7:00 and 9:00 and 19:00 and 21:00) over a three-month period. This inventory included six scales: global self-esteem, physical self-worth, physical condition, sport competence, physical strength, and attractive body. Cross-correlational and partial cross-correlational analyses were performed at the individual level for the collected time series. The results validated the hierarchical structure of the physical self in most participants and thus confirmed the nomothetic validation procedures. This study showed that global self-esteem and physical self-worth present individual hierarchical structure over time. It further demonstrated that an idiographic approach provides a potent means to better understand the functioning of psychological constructs such as physical self.

**Key Words:** global self-esteem, physical self-perceptions, dynamics, time-series analysis

Global self-esteem (or the global construct of the self) is important to mental well-being (Fox, 2000) and physical practice. Fox emphasized that exercise participation is associated with enhanced self-esteem. Moreover, exercise improves physical self-perceptions such as physical self-worth, a domain related to self-esteem (DiLorenzo, Bargman, Stucky-Ropp, Brassington, Frensch, & LaFontaine, 1999; McAuley, Mihalko, & Bane, 1997). This construct mediates the path from physical activities to psychological states and facilitates the attainment of other desired outcomes such as physical activity tolerance, exercise adherence, and health-related physical fitness (Fox).

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In sport psychology, the major advancements in modeling have been stimulated by researches that have focused on the organization of self-esteem components. In recognition of a multidimensional structure of the self (Shavelson, Hubner, & Stanton, 1976), self-esteem is considered to be the combination of distinct self-assessments relative to specific domains of competence (Harter, 1982; Harter, Bresnick, Bouche, & Whitesell, 1998). Then, the physical domain was investigated as an entity through hierarchical models (see figure 1) that have sought to delineate the constitution of the physical self in more details (Fox & Corbin, 1989; Marsh, Richards, Johnson, Roche, & Tremayne, 1994; Ninot, Delignières & Fortes, 2000). Global self-esteem (GSE), the feeling that everyone has about his or her own value, is located at the apex of the model. The median level is occupied by physical self-worth (PSW). According to Fox and Corbin (1989), PSW reflects the general feelings of happiness, satisfaction, pride, respect, and confidence in the physical self and can be decomposed into four subdomains: physical condition, sport competence, physical strength, and attractive body. Physical condition (PC) represents perceptions of one's level of physical condition, fitness, and stamina; one's ability to maintain exercise; and one's confidence in the exercise and fitness setting. Sport competence (SC) corresponds to the perceptions of sport and athletic ability, ability to learn sport skills, and confidence in the sport environment. Physical strength (PS) is related to perceived strength, muscle development, and confidence in situations requiring strength. Finally, attractive body (AB) corresponds to the perceived attractiveness of the body, the ability to maintain an attractive body, and confidence in one's appearance.



**Figure 1.** Hierarchical model of self-esteem. The physical domain is particularly developed (adapted from Fox & Corbin, 1989).

All previous tests of the hierarchical structure have been performed from a nomothetic perspective. In studies using the Physical Self Perception Profile (PSPP) or derived inventories, self-report data were collected from a large sample of participants (365 in the original validation by Fox and Corbin) and analyses were performed from one single assessment (Fox & Corbin, 1989; Ninot et al., 2000; Ninot, Fortes & Delignières, 2001; Page, Ashford, Fox, & Biddle, 1993; Sonstroem, Speliotis, & Fava, 1992; Sonstroem, Harlow, & Joseph, 1994). A second assessment was generally performed some weeks later to test construct reliability. The statistical analyses, based on the comparison between correlations and partial correlations controlling for the median level of the model, confirmed the hierarchical structure of the data set at this collective

level and the timelessness of this organization some weeks later. Nevertheless, the relevancy of these validations based on group data remains questionable as one could consider that they only reveal the average organization of a momentary multifaceted self-assessment.

Two main objections can be raised. The first is that the hierarchical hypothesis mainly refers to individual psychological functioning. This hypothesis suggests that each dimension may influence the others from bottom-up, top-down, or reciprocal directions (Marsh & Yeung, 1998). In other words, the information contained in a given dimension diffuses to the proximal ones, in the ascending or descending direction, or both. The debate about the direction of influences seems to favor the bottom-up hypothesis, according to which the causal flow is from the base of the model to higher order factors (Byrne, 1996; Harter, 1986, 1990; Shavelson et al., 1976). This debate was enriched by the introduction of the perceived importance hypothesis (Fox & Corbin, 1989), which suggests that the influence of a given component in the model is related to its subjective importance. This constitutes a strong argument for an individual view of the hierarchical hypothesis. Perceived importance can be conceived as a filter which modulates the respective weights of the components of a given level. As such, one subdomain should be more related than others to the median level, and the positive or negative evolution of a dimension considered to be unimportant should not have a noticeable influence on the other dimensions. In light of these arguments, it seems more relevant to show that each individual's system is hierarchical, rather than to base the demonstration on an average model representing only the aggregation of qualitatively different individual models.

It is important to note that previous validations of the hierarchical structure were based on the correlational analysis of single assessments, and as such could only reveal relationships between levels in the dimensions. In other words, relationships observed between dimensions depend on their position (high versus low) among the response scale at this particular time and a strong relation exists when the dimensions present similar scores independently of their evolution. A positive correlation between two dimensions in the model is found when these dimensions tend to be simultaneously high or, conversely, simultaneously low among participants. The hierarchical hypothesis, however, does not assume a diffusion of the levels between dimensions, but rather a diffusion of the evolutions: If a life event causes a depreciation, or conversely an enhancement of a given sub-domain (PS, PC, AB, or SC), a similar evolution is expected for the corresponding domain (PSW). Two coupled dimensions should present a significant correlation between their trends in time even if their levels (or scores) are quite distant. For example, PSW having a mean of 8.5 among participants can be strongly related to SC having itself a mean of 5.3 because of their analogous time evolutions in time. In other words, the hierarchical hypothesis suggests more a synchrony between the dynamics of the dimensions than a correlation between their instantaneous positions.

The hierarchical hypothesis should thus be conceived as essentially individual and dynamic. As a consequence, a relevant validation of this hypothesis should be based on an analysis of the relationships between individual time series that represent the evolution in time of the hierarchical model's dimensions. In the present paper, our strategy was based on the comparison (at the individual level) between cross-correlation coefficients and partial cross-correlation coefficients controlling for the median level of the model. We applied Fox and Corbin's criteria (1989) for accepting the hierarchical hypothesis.

Individual time series must be collected for a sufficient duration to calculate cross-correlation coefficients. The aforementioned classical questionnaires were not created to produce such time series. Their completion is relatively time consuming and could rapidly become boring with a protocol of repeated assessments. In addition, their response mode (ordinal Likert scales) could induce a learning effect with repetition. These questionnaires have sometimes been used in longitudinal experiments (e.g., Marsh & Craven, 1997) but the number of repeated measures never exceeded six, with generally several weeks or months between successive assessments. The computation of cross-correlations obviously requires longer time series. In the present work, we used a recently validated questionnaire, the Physical Self Inventory (PSI-6), dedicated to the collection of time series by repeated administration (Ninot et al., 2001).

METHOD

PARTICIPANTS

Eleven participants (4 men and 7 women; mean age = 33.9 years ± 15.0) volunteered for this study. These adults (without psychological disorder and over 24 years of age) were randomly recruited from among the individuals responding to a notice displayed in our university. They were not paid for their participation.

QUESTIONNAIRE

The PSI-6 (Ninot et al., 2001) is a short version of a previously validated questionnaire, the PSI-25 (Ninot et al., 2000), adapted from the Fox and Corbin (1989)'s PSPP. The PSI-6 contains six items, one for GSE, one for PSW, and one for each of the four subdomains (Table 1). Each item is a simple declarative statement to which participants respond using a visual analog scale. The use of such a scale, rather than traditional Likert scales, was motivated by the need to avoid learning effects with repeated measurements.

Table 1  
*Items of the Physical Self Inventory-6 (Ninot et al., 2001)*

Code	Item
Global Self-Esteem (GSE)	Globally, you have a good opinion of yourself
Physical Self-Worth (PSW)	You are proud of who you are and what you can do physically
Physical Condition (PC)	You should be good in an endurance test
Sport Competence (SC)	You manage well in all the sports
Attractive Body (AB)	You think that you have a body pleasant to look at
Physical Strength (PS)	When you come to situations requiring strength, you are among the first to step forward

## PROCEDURE

Each participant completed the PSI-6 twice a day, between 7 am and 9 am and between 7 pm and 9 pm, over a three-month period to provide us with time series reflecting day-to-day self-perceptions. The completion was performed on personal computers using dedicated software. This procedure helped to avoid biases such as social desirability. The six items were presented successively in random order to avoid systematic responses. Participants had to move the cursor along a line anchored by "not at all" at the left extremity and "absolutely" at the right. The software then determined the distance of the cursor from the left extremity and converted the response to a score ranging from 0.0 to 10.0. Participants were not informed of these numerical scores and were not allowed to consult their previous responses. We obtained 182-point time series for each scale and each participant.

## STATISTICAL ANALYSES

The statistical approach was based on the computation of cross-correlations between scales (Chatfield, 1984; Shumway & Stoffer, 2000). A cross-correlation coefficient is simply a Bravais-Pearson correlation coefficient computed between two time series, which then assesses the covariation *in time* of the two variables. Cross-correlations can be computed by considering pairs of simultaneous data points. In this case, the cross-correlation coefficient measures the synchrony of the evolutions of the two time series. Cross-correlation coefficients can also be computed by considering a given time delay between the series. The cross-correlation of time lag  $k$  is obtained by pairing the point  $t$  of one series with the point  $t + k$  of the other. This lagged cross-correlation measures the relation that persists between the two series after the time delay introduced in the computation. Cross-correlations can be computed for a number of negative and positive lags (depending of the length of the series), and then a cross-correlation function (CCF) can be established, relating each lag to its corresponding coefficient. One can easily understand that the maximum of such a CCF has high significance for the analysis of the influences between dimensions in the hierarchical model, and especially concerning the direction of these influences. A maximum centered on lag zero suggest a strong coupling between the series, characterized by synchronic evolutions. In this case, the diffusion of information between the assessed dimensions can be considered as immediate, at least considering the sampling frequency. A maximum at a lag other than zero suggests a *latency phenomenon* in the diffusion of information between dimensions. In others words, when a specific evolution appears in one series, a similar evolution is generally discernable in the second one after a specific delay. The lag represents the time delay necessary for the diffusion of information from one series to the other, and its sign (positive or negative) indicates the direction of the influence between the two series. The first statistical step was thus the analysis of the CCF to reveal any latency phenomena or delays in diffusion between model variables.

A second step investigated the hierarchical structure of the physical self by conjoined analyses of cross-correlations and partial cross-correlations, controlling for the supposed median level of the model (PSW), in order to test the hierarchical hypothesis for each subject. As suggested by Fox (1990), the following criteria were assumed to support the hierarchical hypothesis: (a) PSW should appear to have the strongest relationship with GSE, (b) the four subdomain subscales should exhibit stronger relationships with PSW than with GSE, (c) the relationships

between the subdomains and GSE should be extinguished or significantly reduced with a partial correlation procedure controlling for PSW, and (d) the relationships between subdomains should be weaker than those between subdomains and PSW and should be extinguished or significantly reduced with a partial correlation procedure controlling for PSW.

To test the significance of differences between cross-correlation and partial cross-correlation coefficients, each coefficient was submitted to the z-Fisher transformation, and then a t statistic was computed for each relevant pair of coefficients according to the specific procedure proposed by Fisher (1970).

## RESULTS

### LATENCY PHENOMENON

A peak-finding algorithm was applied to each CCF and allowed to show that the maximum of the function was always located at lag zero ( $p < 0.01$ ). This result confirmed an immediate diffusion of information within the model, at least considering our sampling frequency of approximately 12 hours. As a consequence, the following analyses were systematically performed with zero-lag cross-correlations and partial cross-correlations.

### RELATIONSHIPS BETWEEN GLOBAL SELF-ESTEEM AND SUBDOMAINS

Table 2 presents the individual cross-correlation coefficients between GSE and the physical-self subscales, as well as the partial cross-correlation coefficients between each subdomain and GSE, controlling for PSW. As can be seen, the cross-correlation coefficients were all significant, offering strong support for the convergent validity of the physical-self responses in relation to GSE. In order to test the first criterion proposed by Fox and Corbin (1989), we compared the mean cross-correlation z-coefficients between each subdomain and PSW and between each subdomain and GSE. The subdomains generally exhibited stronger correlations with PSW than with GSE. This result confirms the fact that subdomains (PC, SC, and PS) are closer to PSW than to GSE for each individual model. Nevertheless, the attractive body subscale did not meet this criterion, with no significant difference between z-coefficients with PSW or GSE (PC: 1.17 vs .85,  $t = 2.96$ ,  $p < 0.01$ ; SC: 1.04 vs .81,  $t = 2.18$ ,  $p < 0.05$ ; AB: 1.00 vs .94,  $t = 0.56$ , ns; PS: 1.08 vs .77,  $t = 2.89$ ,  $p < 0.01$ ).

We then analyzed the effects of controlling PSW on the relationships between subdomains and GSE. As can be seen, the partial correlation procedure reduced the coefficients, but did not entirely extinguish the relationships between subdomains and the apex. In order to test for significant differences between these coefficients, the values of Fisher's  $t$  were computed. As shown in Table 3, the decrease in cross-correlation following the partial correlation procedure was generally significant, confirming that the path between subdomains and GSE is always mediated by PSW. This result evidences the hierarchical structure of the model at the individual level. The only exceptions were reported for the PC, AB, and PS scales of participant 6: in these cases the decrease in coefficients was not sufficient to reach significance.

Table 2

Individual cross-correlation coefficients ( $r$ ) between physical self components and GSE and individual and partial cross-correlation coefficients (Partial) controlling for PSW between each subdomain and GSE

Participants Gender - Age	GSE-PSW $r$	GSE-PC $r$	GSE-PC Partial	GSE-SC $r$	GSE-SC Partial	GSE-AB $r$	GSE-AB Partial	GSE-PS $r$	GSE-PS Partial
1 F (24)	0.57***	0.52 ***	0.13 <sup>NS</sup>	0.58***	0.39***	0.68***	0.47***	0.53***	0.16 *
2 M (24)	0.86***	0.87***	0.51***	0.82***	0.35***	0.95***	0.82***	0.74***	0.15 <sup>NS</sup>
3 M (31)	0.51***	0.50***	0.06 <sup>NS</sup>	0.49***	0.07 <sup>NS</sup>	0.54***	0.29***	0.49***	0.05 <sup>NS</sup>
4 F (26)	0.81***	0.80***	0.45***	0.78***	0.44***	0.77***	0.43***	0.78***	0.43***
5 F (24)	0.60***	0.61***	0.23**	0.61***	0.36***	0.54***	0.29***	0.60***	0.21**
6 F (70)	0.45***	0.61***	0.47***	0.38***	0.11 <sup>NS</sup>	0.51***	0.36***	0.49***	0.32***
7 F (52)	0.87***	0.86***	0.26**	0.83***	0.23**	0.82***	0.21**	0.75***	0.34***
8 F (28)	0.86***	0.79***	0.17*	0.77***	0.07 <sup>NS</sup>	0.87***	0.51***	0.76***	-0.01 <sup>NS</sup>
9 F (24)	0.70***	0.52***	0.09 <sup>NS</sup>	0.51***	0.06 <sup>NS</sup>	0.66***	0.26***	0.56***	0.09 <sup>NS</sup>
10 M (43)	0.71***	0.56***	0.30***	0.58***	0.29***	0.39***	0.33***	0.62***	0.34***
11 M (27)	0.82***	0.69***	0.22**	0.77***	0.32***	0.61***	0.10 <sup>NS</sup>	0.68***	0.15 <sup>NS</sup>

(\*\*\*:  $p < .001$ ; \*\*:  $p < 0.01$ ; \*:  $p < .05$ ; NS: not significant; M: Male; F: Female; GSE: Global Self-Esteem, PSW: Physical Self-Worth, PC: Physical Condition, SC: Sport Competence, AB: Attractive Body, PS: Physical Strength)

Table 3

Fisher's  $t$  for the comparison of individual zero-lag cross-correlation coefficients and partial cross-correlation coefficients controlling for PSW, between the four subdomains and GSE

Participants	PC	SC	AB	PS
1	4.15***	2.45*	3.03***	4.10***
2	7.22***	7.38***	6.79***	7.59***
3	4.57***	4.45***	2.91***	4.61***
4	5.87***	5.36***	5.26***	5.46***
5	4.57***	3.13***	2.88***	4.57***
6	1.94 NS	2.71**	1.69 NS	1.89 NS
7	9.51***	9.06***	8.91**	5.80***
8	8.60***	9.01***	7.47**	9.52***
9	4.62***	4.73***	4.93**	5.06***
10	3.08***	3.41***	4.83**	3.52***
11	6.01***	6.49***	5.85***	6.38***

(\*\*\*:  $p < 0.001$ ; \*\*:  $p < 0.01$ ; \*:  $p < 0.05$ ; NS: not significant; PC: Physical Condition, SC: Sport Competence, AB: Attractive Body, PS: Physical Strength)

RELATIONSHIPS BETWEEN SUBDOMAINS

The coefficients of cross-correlation between the four subdomains were reduced but not entirely extinguished following the partial cross-correlation procedure controlling for PSW (Table 4). The values of Fisher’s *t* for the comparison of each cross-correlation coefficient with the corresponding partial cross-correlation coefficient are presented in Table 5. All differences were significant. These results suggest that relationships between the subdomains are not directly conceivable but exist through the mediation of PSW. It clearly confirms the hierarchical structure at the subdomain level and reinforces the mediate position of PSW in the model.

**Table 4**  
*Individual zero-lag cross-correlation and partial cross-correlation coefficients controlling for PSW between subdomains*

P.	PC-SC		PC-AB		PC-PS		SC-AB		SC-PS		AB-PS	
	r	partial	r	partial	r	partial	r	partial	r	partial	r	partial
1	0.58***	0.29***	0.75***	0.43***	0.85***	0.62***	0.63***	0.40***	0.51***	0.13 <sup>NS</sup>	0.73***	0.38***
2	0.91***	0.67***	0.87***	0.48***	0.80***	0.33***	0.83***	0.38***	0.89***	0.67***	0.76***	0.16 <sup>NS</sup>
3	0.95***	0.64***	0.81***	0.55***	0.96***	0.66***	0.85***	0.65***	0.95***	0.59***	0.81***	0.52***
4	0.78***	0.47***	0.85***	0.64***	0.82***	0.56***	0.80***	0.55***	0.76***	0.46***	0.85***	0.67***
5	0.58***	-0.01 <sup>NS</sup>	0.53***	0.02 <sup>NS</sup>	0.87***	0.45***	0.67***	0.47***	0.59***	0.07 <sup>NS</sup>	0.49***	-0.05 <sup>NS</sup>
6	0.56***	0.16 <sup>NS</sup>	0.50***	0.23**	0.73***	0.58***	0.57***	0.35***	0.63***	0.41***	0.48***	0.28***
7	0.91***	0.48***	0.89***	0.40***	0.76***	0.32***	0.91***	0.53***	0.70***	0.15 <sup>NS</sup>	0.63***	-0.04 <sup>NS</sup>
8	0.90***	0.56***	0.83***	0.28***	0.86***	0.36***	0.78***	0.09 <sup>NS</sup>	0.88***	0.47***	0.74***	-0.13 <sup>NS</sup>
9	0.67***	0.40***	0.72***	0.42***	0.83***	0.68***	0.61***	0.20**	0.63***	0.28***	0.66***	0.23**
10	0.59***	0.40***	0.54***	0.23**	0.66***	0.50***	0.64***	0.36***	0.73***	0.58***	0.67***	0.39***
11	0.78***	0.45***	0.79***	0.57***	0.80***	0.54***	0.77***	0.47***	0.76***	0.37***	0.77***	0.51***

(\*\*\*: *p* < .001; \*\*: *p* < 0.01; \*: *p* < .05; NS: not significant; PC: Physical Condition, SC: Sport Competence, AB: Attractive Body, PS: Physical Strength)

**Table 5**  
*Fisher’s t for the comparison of individual zero-lag cross-correlation coefficients and partial cross-correlation coefficients controlling for PSW, between subdomains*

Participants	PC-SC	PC-AB	PC-PS	SC-AB	SC-PS	AB-PS
1	3.55***	4.93***	5.23***	3.06***	4.05***	5.11***
2	6.57***	7.60***	7.01***	7.57***	6.00***	7.84***
3	10.42***	4.88***	11.25***	4.34***	10.52***	5.10***
4	5.07***	4.60***	4.94***	4.47***	4.78***	4.31***
5	6.32***	5.37***	8.06***	2.90***	5.81***	5.55***
6	4.47***	2.95***	2.57**	2.66***	2.88***	2.27**
7	9.67***	9.56***	6.21***	8.60***	6.76***	7.43***
8	7.84***	8.38***	8.58***	9.12***	8.34***	10.24***
9	3.71***	4.24***	3.54***	4.81***	4.34***	5.24***
10	2.39**	3.52***	2.36**	3.52***	2.48**	3.69***
11	.32***	4.14***	4.73***	4.71***	5.67***	4.34***

(\*\*\*: *p* < .001 ; \*\*: *p* < 0.01; \*: *p* < .05 ; NS : not significant; PC: Physical Condition, SC: Sport Competence, AB: Attractive Body, PS: Physical Strength)

## DISCUSSION

The purpose of this study was to re-examine the hierarchical hypothesis in the domain of physical self from an individual and dynamic point of view. Fox and Corbin (1989) proposed a method to test this hypothesis based on the comparison of the correlation coefficients between the apex level of the system and the subdomains and the corresponding partial correlation coefficients, controlling for the median level of the model. Applied to nomothetic data, this method satisfactorily validated the hierarchical organization of the self (Fox & Corbin, 1989; Page et al., 1993; Sonstroem, et al., 1992). On the basis of a theoretical analysis of the hierarchical hypothesis, we proposed to apply this method and its criteria to individual time series collected twice a day using a brief inventory over a three-month period.

The analysis of CCFs allowed us to test for the presence of latency phenomena in the diffusion of information between model scales. We systematically obtained maxima centered on lag zero, suggesting that the influence between scales was not delayed in time, at least considering the sampling frequency used in the present study. One can assume that a time interval of 12 hours is sufficient for the diffusion of information from the subdomains to the apex of the model. As can be seen in Figure 2, the time series recorded for a given participant shared a common dynamics and displayed similar patterns. We argued in the introduction that the examination of CCFs would theoretically allow us to conclude on the direction of causal flow in the model. The absence of shift in the maximum of the obtained functions prevented us from such analyses. Nevertheless, the rationale for this procedure remains valid and further studies using higher sampling frequencies should reveal the true dynamics of information diffusion in the model.

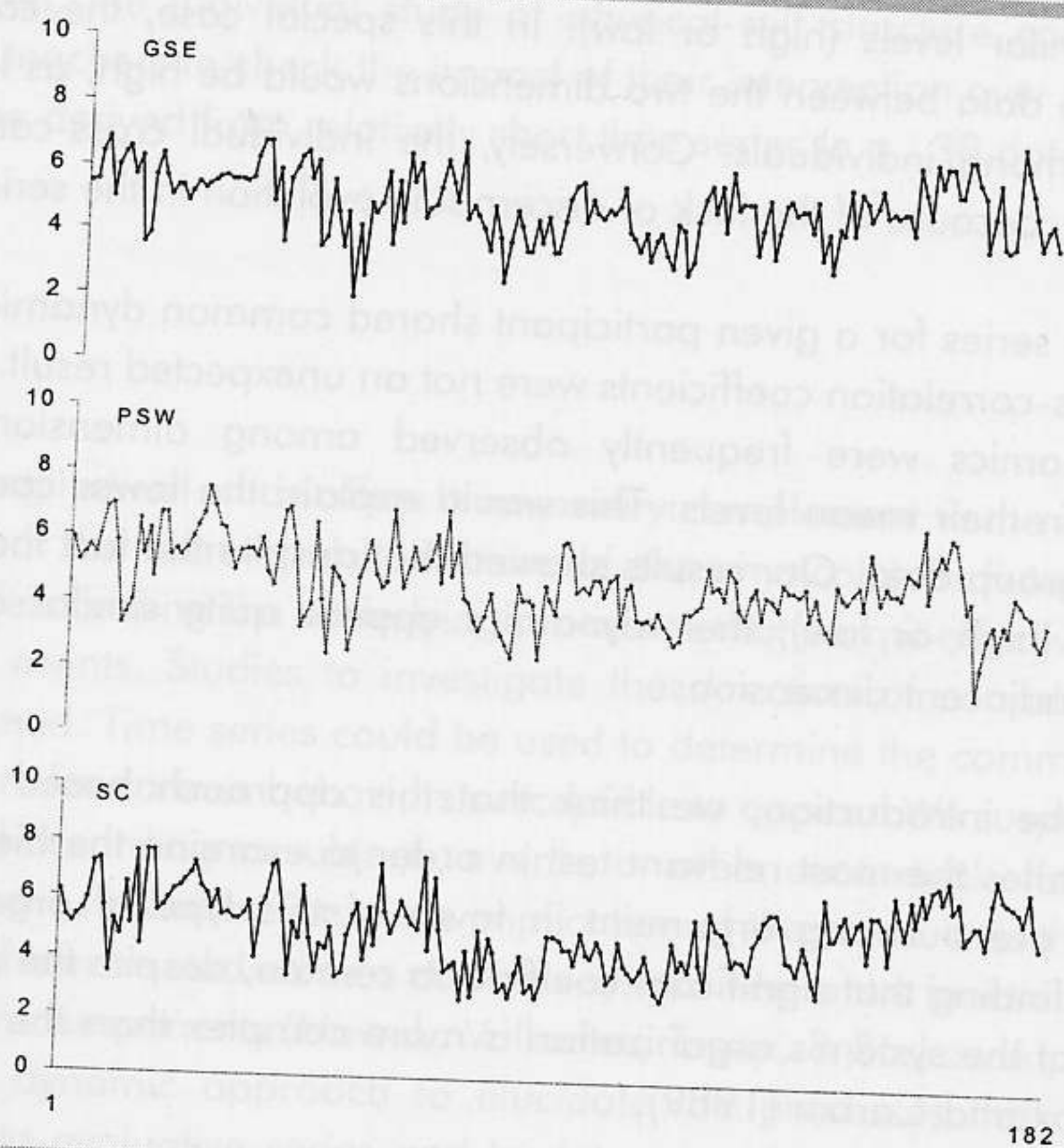


Figure 2. Example of individual time series of global self-esteem (GSE), physical self-worth (PSW) and sport competence (SC).

Our analyses of the cross-correlation and partial cross-correlation patterns showed that the criteria proposed by Fox and Corbin (1989) were satisfied in most cases. Generally, subdomains presented higher cross-correlation coefficients with PSW than with GSE, as expected for a hierarchical organization. No significant difference was obtained for the AB subscale, however, suggesting a quite direct link between this subdomain and the apex of the model. This result was previously observed in nomothetic studies based on group of adolescents (Harter, 1993) and adults (Berscheid, Dion, & Walster, 1971; Fox, 1997; Harter, 1990; Ninot et al., 2000; Ninot et al., 2001; Sonstroem et al., 1992; Sonstroem et al., 1994) and constitutes a confirmation, from the present individual and dynamic perspective, of the special status of body appearance in the physical self (Fox, 1997).

The cross-correlation coefficients between GSE and subdomains and between subdomains were in most cases significantly higher than the corresponding partial cross-correlation coefficients, controlling for PSW. Despite a significant decrease, the coefficients were not systematically extinguished by the partial cross-correlation procedure (see Tables 2 and 4). One could note that in previous studies based on group data (Fox & Corbin, 1989; Ninot, et al., 2001; Page et al., 1993), the correlation coefficients between GSE and subdomains and between subdomains were generally lower than the cross-correlation coefficients observed in the present work, and were often statistically extinguished by the partial correlation procedure. This discrepancy is obviously related to the nature of the calculations involved in each method. As exposed in the introduction, correlations in group data approaches are sensitive to the degree of similarity between the instantaneous positions of each participant on the different dimensions of the model. In contrast, cross-correlations within each individual are sensitive to the similarity of dimensions dynamics. Imagine, for example, two dimensions which would remain, for most individuals, extremely stable and with similar levels (high or low). In this special case, the correlation coefficient computed on group data between the two dimensions would be high, as levels (positions) are strongly coupled among individuals. Conversely, the individual cross-correlation coefficients should be quite low, because of the lack of discernable evolution in the series.

Generally, the time series for a given participant shared common dynamics (see Figure 2): as such, the high cross-correlation coefficients were not an unexpected result. On the other hand, these shared dynamics were frequently observed among dimensions presenting clear differences between their mean levels: This would explain the lower coefficients reported in studies based on group data. Our results showed that despite the fact that dimensions evolve at different levels (high or low), their dynamics appear quite similar and this similarity is stronger between adjacent dimensions.

As explained in the introduction, we think that this approach based on cross-correlation procedures constitutes the most relevant test in order to examine the hierarchical hypothesis. Thus, our results are a strong argument in favor of this type of organization in the self. Nevertheless, the finding that significant coefficients remain, despite the control of the median level, suggests that the system's organization is more complex than the hierarchical structure popularized by Fox and Corbin (1989).

Individual analyses showed that participant 6 did not present a hierarchical functioning on three subscales (PC, AB, and PS). It is important to note that this participant was the oldest of

the group (70 years old). One might assume that, in this age range, physical self is less influenced by daily events than in younger people (Biddle, Fox, & Boutcher, 2000). Elderly people are less active, especially with their body (Kelly, Steinkamp, & Kelly, 1986). Moreover, the cross-correlations between physical-self components and GSE were weaker, although still significant, for participant 6 than for the other 10 participants (aged between 24 and 52 years). This might indicate that this participant did not invest the physical domain due to the sedentary lifestyle associated with aging (Boutcher, 2000; Lemon, Bengtson, & Peterson, 1972). Aging influences self-perceptions by imposing functional limitations such as chronic disease, musculo-skeletal symptoms, or hypertension. The elderly do not go out of the house for physical leisure activities as often as younger people and can lose interest in life. Further research to determine the outcomes of aging on physical-self hierarchical structure would be interesting.

The cross-correlation coefficients between PSW and the subdomains revealed the relative influence of each subdomain on the median level of the hierarchical model. Fox (1990) introduced a psychometric tool, the Perceived Importance Profile (PIP), to assess the respective perceived importance of each subdomain. To our knowledge, this inventory has never been validated (Fox, 1997). One could question the possibility of such direct and subjective assessment of perceived importance. Cross-correlation coefficients offer an interesting alternative by an indirect assessment of importance. Our results showed that specific dimensions might not have the same influence on GSE. The individual study of the physical-self structure lets us discriminate between subjects as to the importance attributed to subdomains. One might expect, for example, that athletes would show stronger relationships between physical-self dimensions as compared with chronic disease patients, who disinvest their body. Moreover, the individual study of physical-self structure can help trainers and physical education teachers to check the impact of their intervention over the season. Such an assessment could be derived from relatively short time series (e.g., 30 data points), for clinical purposes.

## CONCLUSION

This three-month longitudinal study offers a necessary complement to the initial studies of Fox and colleagues about the hierarchical structure of the physical self. Future research will be oriented toward understanding the underlying processes that permit effective coping strategies in dealing with life events. Studies to investigate the direction of causality-influence in the model are also planned. Time series could be used to determine the common intra-individual dynamics that account for various behaviors susceptible to appear. We suspect that causal flow can be differentiated according to subjects, events, or other contextual effects, which poses a challenge to nomothetic research. The main implication of these results is that the hierarchical model of physical self can be studied as a complex system where the functioning emerges from the interplay between components (Nowak, Vallacher, Tesser, & Borkowski, 2000). It will thus be fruitful to use a dynamic approach to elucidate the processes that underlie the time evolution of such auto-evaluative series and to determine the dynamics of the relationships observed between the diverse elements of the model.

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